

# Evaluation of bone loss at single-stage and two-stage implant abutments of fixed partial dentures

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## Abstract

**Introduction:** Fixed partial dentures (FPDs) can be supported on implant abutments only or on single-stage and two-stage implants and teeth.

**Purpose:** The purpose of this study was a comparative analysis of bone loss at the single-stage and two-stage implant abutments of fixed partial dentures used to restore missing teeth classified as Class I or Class II according to the Kennedy classification.

**Material and methods:** 32 patients were treated by using 49 FPDs supported on implants and teeth worn for 2-6 years. Bone loss at the implant abutments of FPDs was evaluated by one examiner using a special ruler with a measuring scale and images of implants. Measurements were conducted at 26 single-stage implants and 50 two-stage implant abutments based on panoramic radiographs.

**Results:** Statistical analysis showed that the mean bone loss at implants after 2 years was  $0.70 \text{ mm} \pm 0.50$ . The mean bone loss at implants after 6 years was  $1.73 \text{ mm} \pm 0.41$ .

The bone loss of the alveolar ridge at the single-stage implants was greater than at the two-stage implants but it was not statistically significant.

**Conclusion:** Prosthetic treatment of missing teeth classified as Class I or II according to the Kennedy classification with FPDs may result in bone loss less than 2 mm after 6 years.

Both single-stage and two-stage intraosseous implants can be suitable for the implant-prosthetic treatment of patients with alar lack of teeth.

**Key words:** fixed partial dentures, intraosseous implants, alveolar bone loss.

## Introduction

Alar lack of teeth (Class I and II according to the Kennedy classification) can be treated in the maxilla and mandible with removable dentures or with more comfortable fixed partial dentures. This type of dentures can be supported on implants only or on implants and teeth. The problem of connecting teeth with intraosseous implants in patients with partial loss of teeth is often discussed, because intraosseous implants are attached to the bone in a different way from natural teeth. Theoretical analysis, the clinical experience of the authors of publications and experimental studies either recommend or discourage the use of rigid connections of teeth with implants when fixed partial dentures are used [1-11].

The majority of authors present their results in terms of implant failure, implant survival and treatment success. There are fewer reports on bone loss at the single-stage and two-stage implant abutments of fixed partial dentures used to treat the lack of teeth in the posterior areas of the dental arch classified as the Kennedy Class I and Class II [12-15].

The purpose of this study was to evaluate alveolar bone loss at the single-stage and two-stage implants as abutments of fixed partial dentures used to replace missing teeth classified as the Kennedy Class I and Class II.

## Materials and methods

The subjects of clinical observations were 32 patients (15 females and 17 males), aged 25-73 (mean age 52), with 49 fixed partial dentures replacing maxillary or mandibular molars or/and premolars. Each FPD was supported by intraosseous implants and teeth (IAFPD – Implant Assisted Fixed Partial Dentures) and the number of tooth abutments and implant abutments var-

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Table 1. Description of patients using fixed partial dentures (FPDs) supported on implants

Number of patients		Age	Number of patients with posterior lack of teeth		Number of bridges supported on intraosseous implants and teeth		Number of implant abutments	
Female	Male		Unilateral	Bilateral	On single-stage implants	On two-stage implants	Single-stage	Two-stage
15	17	25-73 (av.52)	15	17	20	29	29	47
32					49		76	

Table 2. Results of bone loss measurements after 2 and 6 years of using fixed partial dentures

Measurement intervals	Bone loss at both types of implants				Bone loss							
					at single-stage implants				at two-stage implants			
	N	Mean	Median	SD	N	Mean	Median	SD	N	Mean	Median	SD
After 2 years	76	-0.7	-0.5	0.50	29	-0.71	-0.5	0.56	47	-0.69	-0.5	0.44
After 6 years	50	-1.7	-1.5	0.41	27	-1.83	-2	0.40	23	-1.61	-1.5	0.39

ied (Tab. 1). Intraosseous implants of the Osteoplast Implantology System (Poland) were applied in the treatment.

All single-stage Osteoplast-Standard implants (26 abutments) and two-stage Osteoplast-Hex implants (50 abutments) were 3.5 or 4.5 mm in diameter and 9-16 mm in length.

Altogether, the FPDs were supported on 76 intraosseous screw implants and 96 teeth. The implants were inserted in the completely cured bone of the alveolar ridge and loaded prosthetically after 3-5 months.

The tooth abutments of FPDs were vital teeth or teeth endodontically treated. All metal-ceramic fixed partial dentures (IPS Classic of Ivoclar – dental ceramics fused to metal) were retained in the oral cavity by using dental cement. The jaws opposing the ones under examination in 28 patients had either natural dentition or fixed partial dentures supported on teeth. Four patients wore removable partial dentures in the opposing jaws.

Panoramic radiographs of all patients were performed before and after implantation, immediately after the placement of the bridges and during the use of the FPDs (2-year intervals). The apparatus applied was a Soredex Cranex Tome, with a magnification of 130 per cent. In this study the objects of analysis were exclusively panoramic radiographs performed after the placement of the dentures in the oral cavity and after 2 and 6 years of use. Because the length of actual implants and the length of their radiographic images were known it was possible to allow for the error of measurement in the analysis of the radiographs.

A special ruler with images of implants (magnified 130%) and a measuring scale on it was used to analyse the radiographs. The loss of alveolar bone at the implants was determined with the help of a viewbox. Measurements were taken and recorded by one examiner after 2 and 6 years of using the fixed partial dentures. The data were analyzed with the Student test ( $p < 0.05$ ).

## Results

The fixed partial dentures supported distally on the implants and proximally on the teeth of the studied group did

not exhibit any clinical or/and mechanical failures. The bone loss of the alveolar ridge varied both at the single-stage and two-stage implants. A summary of measurements of bone loss at the implants is shown in Tab. 2.

The mean bone loss at the implants after 2 years of using fixed partial dentures supported on mixed abutments was 0.70 mm  $\pm$  0.50 (0.71 mm at single-stage implants and 0.69 mm at two-stage implants) and 1.73 mm  $\pm$  0.41 after 6 years (1.83 mm at single-stage implants and 1.61 mm at two-stage implants). The bone loss of the alveolar ridge at the single-stage implants was greater than at the two-stage implants but the difference was statistically insignificant. It was observed that bone loss at the implants increased during the use of the FPDs and varied in this group of patients. Because only slight atrophy of the bone of alveolar ridge around the fixed partial dentures supported on implants and teeth was observed after 6 years, both single-stage and two-stage implant abutments can be used to treat patients with lack of teeth according to the Kennedy Class I and Class II classification.

## Discussion

Many factors are known to affect bone response at implants, such as the type of implants, the kind of material, surface texture, implant location, anatomic area, surgical procedure and prosthetic treatment [3-5,9-12,14-16].

A varied extent of alveolar bone loss at intraosseous implants in the posterior area of the maxillae and mandible has been observed. Based on a nine-year study, Johansson and Ekfeldt reported that the mean marginal bone loss for the implant abutments of fixed partial dentures was 0.4 mm during the first year after prosthesis insertion and less than 0.1 mm per year in the following years [2]. A three-year observation of tooth-implant units supporting fixed partial dentures by Cardaropoli et al. showed that the mean bone loss was 0.5 mm at the implant and was greater than at the tooth. No differences in the bone changes in the proximal area between the implant and the neighbouring tooth were recorded [3].

Differences in bone loss at implants when fixed partial dentures are used to restore missing teeth according to the Kennedy Class I and Class II classification may be caused by a number of factors. One of them appears to be the posterior location of implant abutments (proximity of muscles of mastication), which in combination with the lack of paradontium at implants may result in unpredictable bone loss in this area.

Based on clinical and radiographic evaluation of bone loss at implants placed at molar and premolar sites, Tawil et al. reported that bone loss over the first year was 0.7 mm and 0.81 mm over a three-year period. Their study demonstrated that there was no significant difference between the bone loss around 5 mm diameter fixtures and adjacent 3.75 mm diameter standard fixtures [16]. Taking into account that finding, we did not examine 3.5 mm and 4.5 mm diameter fixtures separately.

Warren et al. observed during a period of 6-36 months following implant placement that crestal bone loss ranged from 0.0 to 2.1 mm in the posterior region of the alveolar arch [17].

A longitudinal radiographic study of fixed partial dentures supported on implant-tooth abutments conducted by Naert et al. showed that the estimated bone loss for the first 6 months was 0.31 mm per year and was greater in the maxillae than in the mandible. Age and gender did not affect the change in the bone level [4].

Hardt et al. found that during a 5-year examination the mean bone loss in the posterior maxillary segment was 1.7 mm for patients without periodontal disease and 2.2 mm for patients with it [12]. Following a 4-5 year study of bridges supported on implant abutments and tooth-implant abutments, Bragger observed favourable clinical conditions for tooth-implant fixed partial dentures, based on an examination of Branemark implants [5].

Naert, Duyck et al. concluded that there is a positive relation between abutment length and marginal bone level. However, their study showed that bone loss never exceeded 2.2 mm even after 15 years [13]. Following their study of Branemark implants as the abutments of FPDs in the mandible, Lindquist et al. reported a mean bone loss of 0.9 mm after 10 years and 1.2 mm after 15 years of using those dentures [15].

The differences in the results of the clinical and radiological studies of various authors appear to emphasise the complex nature of bone loss at implants and its multi-faceted etiology.

## Conclusions

- Alveolar bone loss at the single-stage implant abutments of fixed partial dentures is not statistically different from bone loss at two-stage implants.
- Both single-stage and two-stage intraosseous implants can be suitable for the implant-prosthetic treatment of patients with alar lack of teeth.

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